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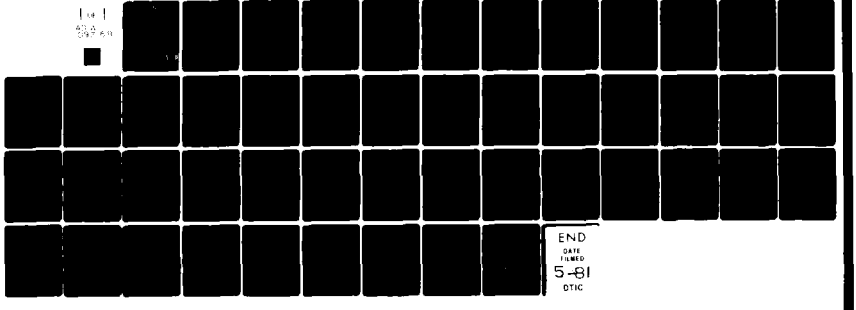

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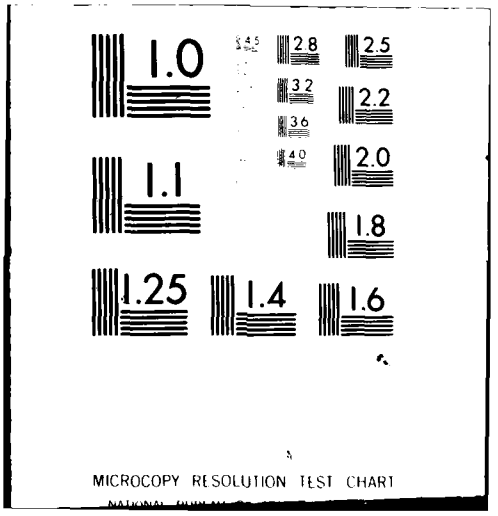
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FRANCIS E. WALTER DAM AND RESERVOIR PROJECT

WATER QUALITY DATA REPORT (RCS-DAEN-CWE-15)

Prepared By

U. S. Army Corps of Engineers
Philadelphia District

COVERS THE PERIOD
OCTOBER 1, 1979 TO SEPTEMBER 30, 1980

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REPORT DOCUMENTATION PAGE

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1. REPORT NUMBER: DAEN/NAP-73825/WQDR80-80/12 ✓	2. GOVT ACCESSION NO.: AD-A091168
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE *(and Subtitle)*: Francis E. Walter Dam and Reservoir Project water quality data report (RCS-DAEN-CWE-15). ~~covers period October 1, 1979 to Sept.~~ 30, 1980	5. TYPE OF REPORT & PERIOD COVERED: Water quality data report Oct, 1, 1979 - Sept 30, 1980
	6. PERFORMING ORG. REPORT NUMBER: DAEN/NAP-73825/WQDR80-80/12
7. AUTHOR(s)	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: U.S. Army Engineer District Philadelphia, 2nd & Chestnut Sts., Philadelphia, PA 19106	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: 12 419
11. CONTROLLING OFFICE NAME AND ADDRESS	12. REPORT DATE: Dec 1980
	13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS *(if different from Controlling Office)*	15. SECURITY CLASS. *(of this report)*: UNCLASSIFIED
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

APPROVED FOR PUBLIC RELEASE ; DISTRIBUTION UNLIMITED

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Francis E. Walter and and Reservoir, Pa.
Bear Creek, Pa
Lehigh River, Pa.
Water quality
Water pollution Land use

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The Francis E. Walter Dam and Reservoir is located at the convergence of Bear Creek and Lehigh River in Luzerne, Carbon and Monroe Counties in Northeast Pennsylvania. The purpose of this report is to present and briefly interpret the water quality collected to date in relation to the operation and control of Francis E. Walter Dam and Reservoir. Included in the report are the general characteristics of the area influenced by the dam, the project and the basin area draining into the lake. —>

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Information is given to show relationships between water quality problems and effects of the lake on the water quality in the area.

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SECTION I - SUMMARY

1-01. Summary. The Francis E. Walter Dam and Reservoir is located at the convergence of Bear Creek and Lehigh River in Luzerne, Carbon and Monroe Counties in Northeast Pennsylvania. The project was completed in 1961. The drainage basin above the dam has not been greatly developed; however, the recent developments such as the Jack Frost Ski Area and a shopping center at Blakeslee's corner has increased the potential for pollution to the impoundment.

The Francis Walter Lake is an oligotrophic lake having few nutrients and little plant life. Furthermore, due to the seasonal fluctuating water levels, trees and plant life have been destroyed within the flooding zone. The Philadelphia District's water quality monitoring program and supportive data has demonstrated that the reservoir is of high water quality. (Appendix A)

The lake is operated as a flood control project with incidental recreation therein and, at times, for recreational white water canoe flow augmentation purposes downstream. The lake is appropriate for fishing, but the pressures exerted far outstrip the fish stocked or indigeneous therein.

Continued monitoring at present levels is a minimum to allow proper future management decisions and adjustments to the monitoring and management effort. The greatest problem to date has been a simple absence of data, which we are correcting through an on-going program. Coordination efforts to extend the program to include a biological program with the assistance of the Pennsylvania Department of Environmental Resources has been effected.

Cursory evaluations to date, aesthetics and considerable popular use of the lake corroborate that it is a valuable resource.

It remains to be demonstrated if the water quality is in fact consistent with this judgment.

SECTION II - INFORMATION

2-01. Purpose and Scope. The purpose of this report is to present and briefly interpret the water quality data collected to date in relation to the operation and control of the F. E. Walter Dam and Reservoir. Included in the report are the general characteristics of the area influenced by the dam, the project itself, and the basin area draining into the lake. The information in this report will be useful for water quality management purposes. It should show relationships between water quality problems and effects of the lake on the water quality and serve as a source of reservoir data. It will also be useful in the planning and design of other projects.

2-02. Authority. This report is submitted in accordance with the Corps of Engineers' policy as authorized in ER 1110-2-334, "Water Quality Management at Corps Civil Works Facilities," 1 May 1974.

2-03. Background Information. Francis E. Walter Dam and Reservoir is located at the convergence of Bear Creek and Lehigh River in Luzerne, Carbon and Monroe Counties in Northern Pennsylvania. The reservoir is 86 miles north of Philadelphia, 20 miles southeast of Wilkes Barre, 39 miles south of Scranton, and 23 miles north of Allentown. The project area is part of the Pocono Mountain region which contains private and public recreation resorts serving primarily the residents of Pennsylvania, New York, and New Jersey. The project is accessible to the public by means of the Northeast Extension of Pennsylvania Turnpike, Interstate Routes 80 and 81, and Pennsylvania Routes 940 and 115. The general location is shown on Plate 1.

Project Structures and Data

a. Dam and Outlet Works

1. Drainage Areas

Total Lehigh River Basin	1,370 square miles
Above Bethlehem	1,279 square miles
Above Dam	288 square miles
Percentage of basin controlled by dam	21%
Percentage of basin above Bethlehem controlled by dam	23%

2. Embankment

Type	Earth fill with impervious compacted earth core; riprap cover.
Top elevation, above sea level datum	1,474 ft.
Height above river bed	234 ft.
Top length	3,000 ft.
Top width	30 ft.
Freeboard above spillway design flood	5.4 ft.

3. Spillway

Type	Concrete ogee overflow section
Location	At northwest end of dam; right bank
Crest elevation	1,450 ft., s.l.d. 450 ft.
Type of channel	Improved natural water course
Total channel length	4,200 feet

4. Reservoir

At spillway crest level (1,450 ft.):

Surface area	1,840 acres
Greatest Length	8.1 miles (along Lehigh River)
Greatest width	4,000 ft.
Total capacity	111,000 acre-ft. (7.16 in. runoff)

Flood control capacity	108,000 acre-ft. (7.03 in. runoff)
Probability of filling to spillway crest	2% chance in any one year
Emptying time from pool elevation 1,450 ft. to 1,300 ft., outflow limited to 10,000 c.f.s. assumed inflow at 1,000 c.f.s.	10 days
At conservation pool level (1,300 ft.):	
Surface area	90 acres
Greatest Length	8,900 ft. (along Lehigh River)
Greatest width	1,200 ft.
Capacity-conservation	2,000 acre-ft. (0.13 in. runoff)
Reservoir shoreline	5 miles. Low flood plain marsh to wooded hills and vertical rock cliffs.

5. Outlet Works

Type	Gate controlled, concrete lined tunnel
Size of conduit	16 ft. diameter, circular
Inert elevation at intake	1,250 ft., s.l.d.
Inert elevation at exit portal	1,238 ft., s.l.d.
Length of conduit (including transitions)	1,150.5 ft.
Control gates	3 sets of 2-5'8" x 10'0" hydraulically operated vertical slide gates

Gate Operation	
Maximum allowable flood control release	10,000 c.f.s.
Potential discharge through three open gates, pool at spillway crest	17,000 c.f.s. (approx.)
Rate of gate movement	0.8 ft./minute (approx)
Time required, one gate, full open to full closed, or closed to full open.	12-1/2 minutes (approx.)
Bypass System	
Number	2
Size of conduits	24" dia. cast iron pipe
Operation	One electrically operated 24" gate valve in each conduit
Intake weirs, elevation	1,297 ft., s.l.d.
Discharge capacity of system (2 units) with reservoir pool at elevation 1,301.	

2-04. Pertinent References. The following references are considered pertinent to this report, (ER 1110-2-1402 and 1130-2-415).

a. Water Quality/Bacteriological Data - Contract DACW61-78-D-0013. Appendix A.

b. Stratification Testing, Philadelphia District. Appendix B. (Not reproduced) available in NAPEN-F files.

SECTION III - AREA AND PROJECT DESCRIPTION

3-01. River Basin Characteristics. The reservoir drainage area and dam site lie entirely within the Pocono Plateau physiographic province. The Pocono Plateau is well dissected, giving a mountainous appearance which is accentuated by the crooked, narrow, steep-walled valleys containing the Lehigh River and its upper major tributaries. In the vicinity of the reservoir site the surface elevations range from about 1,240 feet elevation in the river valley bottom to over 2,000 feet on the plateau proper.

Project lands are predominantly forested except for areas cleared to accommodate project structures and access roads. The lands immediately adjacent to the project are undeveloped, similarly forested, and used only by hunters and occasional hikers. That general condition has resulted in continuity of natural ecosystems in a virtually undisturbed state in a wide belt surrounding the project. Recreational use of project lands compliments that condition by limited and concentrated development sited mostly in the forest-cleared interface or in open space. The high mountain area which is almost totally forested is of great scenic interest and oriented as a summer recreational and winter sports region.

3-02. Project Description. The Francis E. Walter Dam project, completed in 1961, provides for flood storage, incidental recreation and at times, for recreational white water canoe flow augmentation downstream of the dam. The dam is located below the convergence of Bear Creek and Lehigh River in Luzerne, Carbon and Monroe counties. The water, at conservation pool level (1,300 ft.) has a surface area of 90 acres and is 8,900 feet in length along the Lehigh River. The reservoir shoreline is approximately five miles in length and irregular

in shape, one drainage area being the Lehigh River and the other Bear Creek. The shoreline is bounded by wooded hills and vertical rock cliffs limiting accessibility to some areas for fishermen except by the use of boats.

3-03. Climate.[1/] The Lehigh River Basin enjoys a temperate northeast Atlantic Coast climate that is characterized by frequent small changes in temperatures, ranging from - 7°F to 88°F, and relatively frequent but moderate amounts of precipitation totalling 43 inches annually. A more detailed discussion on the climate of the area can be found in Appendix B, DM No. 10A. Selected climatological data for 1980 is found in Table 1.

3-04. Dam and Lake Characteristics.

a. Embankment. The dam is a rock faced earth embankment with an impervious compacted earth core and random fill outer sections, has a crest length of 3000 feet with a maximum height of 234 feet above river bed. The top of the dam is at elevation 1,474 feet (sea level datum). The top of the dam has a width of 30 feet and is surfaced with gravel to serve as a maintenance road. Access to the intake tower is by a service bridge.

b. Spillway. The spillway contains a concrete ogee overflow section which is located at the northwest end of the dam; right bank. The crest length is 450 feet at elevation 1450 feet; s.l.d. The spillway discharge after leaving the improved natural water course, will flow directly into the Lehigh River.

1/ Climatological Data -1980 - Walter Dam Project.

c. Outlet Works. The outlet works is located near the center of the dam and consists of a control tower and intake structure at invert elevation 1250 feet; s.l.d., located on the upstream side of the dam. The tower leads gated water passages through the dam and a conventional stilling basin is provided at the downstream end to dissipate the energy of the conduit discharge.

d. Access Roads to Dam. Access to the top of the dam is from the government road near the spillway up an inclined driveway on the right bank of the impoundment.

e. Reservoir. The reservoir when filled to the top of the conservation pool, elevation 1300, is approximately 8,900 feet long (along Lehigh River) and 1,200 feet at point of maximum width. The average depth of the reservoir is about 25 feet and the maximum is 50 feet. The lands bordering the existing impoundment are characterized by many steep, rocky slopes and nearly vertical rock walls. Project lands are forested except areas that were cleared for project implementation. Adjacent lands are similarly forested and undeveloped except along principal highways where seasonal homes and recreational complexes are found. Recreational facilities presently provided at the project consist of picnicking, fishing, boat launching, hunting, sightseeing and hiking trails. The scenic and rugged beauty of the area is a prime moving factor for a general increase in attendance at Walter Dam over the past few years.

3-05. Geological History. The general geology and topography of the Lehigh River Basin in which Francis E. Walter Dam is located have been described in detail in Appendix B, DM No. 10A. The reservoir drainage area and the dam site lie entirely within the Pocono Plateau which is small, southeast trending lobe of the Appalachian Plateau physiographic province. The Pocono Plateau is well dissected, giving a mountainous appearance which is accentuated by the crooked, narrow steep-walled valleys containing the Lehigh River and its upper major tributaries. In the vicinity of the reservoir site the surface elevations range from about 1,240 in the river valley bottom to over 2,000 on the plateau proper.

Two or more glaciers passed over the region, the results of the last being well preserved. The glacial action planed the area into broad expanses of thinly covered striated sandstone bedrock. During the melting of the last glacier an outwash deposit of boulders, gravel and sand filled the river valley in the reservoir area and at the dam site to a depth of more than 100 feet. Postglacial stream flow has removed much of this glacial outwash leaving as remnants terraces on the steep valley slopes. The Pocono Plateau is composed of gently undulating sandstones and shales belonging to the Catskill continental series of the Devonian system. At the dam site the bedrock is an extremely hard silica-cemented gray sandstone and conglomerate containing quartz pebbles up to one inch diameter, with occasional thin beds of gray to black shale. The thick to massive bedded sandstone and conglomerate have a rectangularly arranged joint pattern which is normal for flat-lying rock.

3-06. Topography. The lands bordering the existing impoundment are characterized by many steep, rocky slopes and nearly vertical rock walls. The west bank of the impoundment contains rock walls up to 100 feet high from the dam upstream into Bear Creek for a distance of about 400 feet. The east bank contains steep rocky slopes from the access road upstream for about 1,000 feet, a multi-level borrow area for the next 1,000 feet to the confluence of the Lehigh River. The bank becomes a nearly vertical rock wall at the 1,300 foot elevation on the south side of the Lehigh River.

3-07. Soils Description.

The soils of both Carbon County and Luzerne County have been exhaustively studied and catalogued by the U.S. Soil Conservation Service in cooperation with Pennsylvania State University and the Pennsylvania Department of Agriculture. The soils at the project are well drained to moderately well drained. Refer to project master plan for a further discussion.

Soils are:

(a) Arnot Series. The Arnot soils are shallow, well drained upland soils formed in glacial till derived from acid sandstone, siltstone and some shale. They have a rocky silt loam surface layer and a thin channery silt loam subsoil. Sandstone bedrock occurs at above 17 inches.

(b) Barbour Series. The Barbour soils consist of deep, well drained soils on floodplains formed from reddish colored stream deposits. They have a silt loam surface texture and a silt loam or sandy loam subsoil which is stratified in the lower part with sand and gravel.

(c) Bath Series. The Bath series consist of deep, well drained upland soils formed in glacial till derived from acid sandstone and shale. They have a channery silt loam to a very stony silt loam surface layer and a channery loam subsoil. A slowly permeable fragipan occurs at about 29 inches.

(d) Chenango Series. Chenango soils consist of deep, well drained to somewhat excessively drained soils of stream terraces and kames derived from gravelly outwash material. They have a gravelly loam surface layer, a very gravelly loam or very gravelly sandy loam subsoil and a stratified sand and gravel substratum.

(e) Dekalb Series. The Dekalb series consist mainly of stony steep mountainous soils that have formed in shallow to moderately deep frost-worked material. The series is moderately deep and well drained on uplands formed from sandstone. Sandstone bedrock occurs at about 34 inches.

(f) Lackawanna Series. The deep, well drained soils of the Lackawanna are found on uplands formed from reddish glacial till. They have a very stony silt loam surface layer and a channery loam subsoil. A slowly permeable fragipan occurs at about 26 inches.

(g) Leck Kill Series. The Leck Kill series consist of moderately deep, well drained, medium-textured soils that have a dark reddish-brown to black surface layer and a brown to reddish-brown subsoil. The soils have formed from a mixture of reddish-brown siltstone, shale and fine sandstone that has been reworked by glaciers. The bedrock underlying this material is mostly reddish-brown, but in places it is weak red or dark red.

(h) Mardin Series. The Mardin series are deep, moderately well drained soils on uplands formed from glacial till containing sandstone. They have a channery silt loam surface layer and a channery loam subsoil. A slowly permeable fragipan occurs at about 15 inches.

(i) Meckesville Series. The Meckesville series consist of medium-textured, deep, well drained soils that have a dark-brown surface layer and a reddish-brown subsoil. These soils are mostly stone and are wooded. They have formed a pre-Wisconsin glacial till consisting of mexed red, brown, and gray sandstone and siltstone with some conglomerate and shale.

(j) Oquaga Series. The Oquaga series consist of moderately deep, well drained upland soils formed in glacial till and frost churned materials derived from reddish acid sandstone interbedded with shale. They have an extremely stoney silt loam surface layer and a very channery loam or slaggy loam subsoil. Bedrock is about 26 inches.

(k) Very Stony Land. The mapping units in this miscellaneous land type consist of stones, boulders and outcrops of rock. The areas are too steep and stony for any use except shrubs and slow-growing trees. In places geologic erosion is keeping pace with the soil-forming process.

(l) Wellsboro Series. Wellsboro soils consist of deep, moderately well drained loamy soils of the glaciated uplands. These soils have a thick, compact, slowly permeable fragipan in the subsoil and a high water table that normally rises to within 18 inches of the surface during the winter and spring months. They have a moderate available moisture holding capacity, medium natural fertility and a few too many stone fragments.

3-08. Vegetation. The vegetative cover representative of the Pocono plateau region extends for miles in three directions from the project site. South of the project, however, the topography begins to abruptly fall to lower elevations where vegetation is more lush and supports greater numbers of conifers and oak. Hickory Run State Park, four miles south of the project, is generally 100 feet lower in elevation. Valleys of that lower elevation are broader than those of the project and therefore support greater concentrations of moisture-loving plant species. The lusher aspects of the lower elevations are reflected in the two largest valleys in the present project and to some extent in intermittent spots along the pool perimeter. For the large part, the project supports Pocono Plateau hard-woods at the higher elevations. Project modifications will not change the ratio of those two plant communities, but will present them further upstream on lands to be acquired. Refer to appendix D, DM No. 10A for inventory and expanded discussion.

3-09. Land Use. Management of the project has little effect on the ecosystems within the presently limited project lands, except in the shoreline zone of the reservoir. Existing and proposed recreational facilities are designed to have a minimal impact on the environment and to preserve the character of the region as it extends into the Federal Reservation. A more detailed study of the area ecology can be found in Appendix D, DM No. 10A.

SECTION IV - WATER QUALITY DATA

4-01. Purpose of Sampling Program. The purpose of taking water samples at Walter Lake is to maintain a constant inventory of the water quality within the area influencing and influenced by the lake. Other sample sites, shown in Plate 1, indicate water quality upstream and downstream, as well as within, the lake. Analysis of these samples gives an understanding of the effect of the lake on water quality:

a. The relationship to the water quality problems within the basin;

b. To provide warning of detrimental effects to water uses;

c. To determine effects of lake on water quality; and

d. To provide resource data.

4-02. Testing Procedures and Equipment. Post-impoundment water quality data has been collected periodically since April 1974. Prior to that time, only limited sporadic data collection efforts were made. Data available so far, together with discussions with the Pennsylvania Department of Environmental Resources, Water Quality Division, indicate that present water quality is good. No algae problems exist and standards for waste discharges above and below the dam are directed at maintaining high water quality.

Criteria set by the Commonwealth of Pennsylvania includes the following parameters: pH, dissolved oxygen (DO), temperature, bacteria, iron and total dissolved solids (TDS). The present data collection program covers pH, DO, temperature, and specific conductance as an indicator of TDS. The Corps data collection program also includes testing for Ortho Phosphate, Nitrate and Nitrite, Ammonia and total coliforms.

Water samples are collected under contract by Betz, Converse & Murdoch, Inc. Stratification data is collected by personnel from the Philadelphia District Office. The results of this testing are tabulated in Appendix A of this report. The current Pennsylvania DER standards for fecal coliforms for swimming beaches is 200 FC/100 ml of sample.

District personnel in conjunction with personnel of the Northern Area Office, continued stratification monitoring at three sites within the lake from May to October 1980. The documented data can be found in Appendix B to this report. (available in NAPEN-E files)

As part of its operation of a state-wide water quality network, the PA.DER operates four stations, one on the Lehigh River at the State Route 115 bridge, another on Tobyhanna Creek at the State Route 940 bridge, one on Bear Creek north of the dam and a station downstream of the dam.

Water quality standards have been established for the Lehigh River from its headwaters to the Francis E. Walter Dam. Those standards which are of concern are:

a. pH - Not less than 6.0 and not more than 8.5.

b. Dissolved Oxygen - No value less than 7.0 mg/l (in the river).
No value less than 5.0 mg/l at any point (in lakes, ponds and impoundments).

c. Iron - Total iron not more than 1.5 mg/l.

d. Temperature - Not more than 5°F rise above natural temperatures or a maximum of 58°F.

e. Dissolved Solids - Not more than 500 mg/l as a monthly average value, not more than 750 mg/l at any time.

4-03. Data Available. Considerable data, collected as a basis for project regulation, are available for analysis. Water quality data;[1/] (temperature, dissolved oxygen, conductivity, pH, phosphorous, total dissolved solids, nitrate, nitrite, ammonia, iron, and total coliform has been collected and documented, on a regular continuing basis for the past six years. Additional data is available from other sources such as the Pennsylvania Department of Environmental Resources, U. S. Geological Survey, Pennsylvania Fish Commission and information collected and filed by the Philadelphia District, Corps of Engineers.

1/ Appendix A - Water Quality /Bacteriological Data

4-04. Reservoir Operation and Hydrology.

The methodology of operation of the project specifically designed for flood control, water storage and control monitoring is set forth in detail in the project Regulation Manual dated 29 Dec 7[illegible]. Briefly that manual states that the existing project will be operated in the following manner. A more detailed discussion will be found in appendix A, DM No. 10A, Reservoir elevation vs. total capacity; - area and capacity curves, Plate 5.

a. Normal operation. Normal operation is defined as the regulation necessary to maintain the reservoir as near Conservation Pool level (elevation 1300) as possible. The range of pool elevations for normal operation is from elevation 1297 to elevation 1306. This allows for a fluctuation of nine feet, from three feet below to six feet above Conservation Pool level. The fluctuations within this range will be as infrequent as possible during periods of high recreational usage (June through September). At the present time there is no provision at Walter Reservoir for low flow augmentation. Normal regulation is therefore limited to the operations necessary to keep the reservoir at or near Conservation Pool level for recreation use, to meet water quality requirements, and to combat mosquito propagation.

b. Flood Control Operation

The operation of the reservoir for flood control is determined by any one of the following criteria:

1. Pool elevations greater than 1306.0 feet (Conservation Pool level plus 6 feet).

2. District Office National Disaster Alert.

3. Reported river stages at control locations equal to, or more than flood stages indicated in the Operational Maintenance Manual.

4. Lehigh basin rainfall reports or predictions of precipitation greater than 1 in./hr., or 2 inches in 6 hours.

5. Reservoir inflow rates in excess of 2,000 c.f.s., or gate openings greater than 6.0 feet required for Normal Operation.

6. Basin snow cover having water equivalent of 3 inches or greater.

7. Reports of severe ice conditions or temporary constrictions at downstream locations.

8. Malfunction of gate operation equipment.

During any of these conditions, control of operations of the reservoir may revert to the District Office. The decision of whether control will revert to the District Office will be determined by the District Office after notification of the occurrence of any of the above situations.

Local Surface Water Hydrology

Approximately 20 percent of the township drains west into the Susquehanna River and the remainder of the land drains either directly or indirectly into the upper reaches of the Lehigh River.

The major receptor of runoff, which eventually reaches the Lehigh River, is Bear Creek. Bear Creek originates in the northeast sector of the township, just below Big Shiney Mountain. This creek flows in a southwesterly direction and continues to gain volume by receiving water from both the Meadow Run Ponds in the east and Lake Aleeda and the Wyoming Mountains region in the west. Throughout the upper reaches of Bear Creek the ground water table approaches surface exposure as is indicated by numerous swamp conditions in the northern central portion of the township.

Upon reaching the center of the township, Bear Creek assumes a southerly flow pattern and eventually drains into Bear Creek Lake. This lake, with a surface area of approximately 100 acres, has a dam at its most southerly boundary. Water passing over the spillway constitutes the continued flow of Bear Creek.

Bear Creek continues to flow in a southeasterly direction for 1,600 feet where it enters an impoundment which has been constructed by the Pennsylvania Gas and Water Company. When the rate of flow in Bear Creek is substantially high, water is pumped from the impoundment to Crystal Lake for use in public water supply systems in Wright and Fairview Townships.

Water passing over the impoundment continues to flow in a southeasterly direction while receiving runoff from both extreme boundaries of the southern portion of the township. Bear Creek eventually empties into the Lehigh River which is immediately impounded by the Francis E. Walter Dam.

At the present time, the flow rate through the dam is monitored by a gaging station located approximately 1 mile downstream of the dam. The fraction of the total flow through the dam which results from the discharge of Bear Creek has been monitored from a gaging station just below Bear Creek Lake which is operated by the Pennsylvania Gas and Water Company. Table _ shows the flow characteristics of the Lehigh River below the Francis E. Walter Dam and the flow of Bear Creek at the Pennsylvania Gas and Water Company impoundment.

SECTION V - INTERPRETATION OF DATA

5-01. General Post-Impoundment Conditions. In general, accumulated data indicated the reservoir is of high water quality. The data indicated a favorable comparison with water quality criteria established by Pennsylvania Department of Environmental Resources as outlined in "Chapter 93: Water Quality Criteria."

During periods of heavy rainfall, streams contributing runoff to the lake as well as the lake exhibit a moderate drop in pH while the ammonia nitrogen levels remained within the Pennsylvania DER Standards of 0.5 mg/l. After the flushing period, the levels of these and other parameters remained uniform and exhibited conformance to established water quality criteria.

The bacteria coliform samples are collected at the same time as the water quality samples and are processed under contract at a certified laboratory in accordance with procedures outlined in Standard Methods for the Examination of Water and Waste Water, 14th Edition. These data are outlined in Appendix A of this report.

The District also plans to continue the stratification testing that was initiated, in 1975.[1/] Data derived will be useful in determining thermoclines and analyzing for selected chemical parameters at various levels throughout the lake.

5-02. Chemistry Data.

a. Nitrogen

The nitrogen cycle in the lake follows the expected pattern; the highest readings on the tributaries showing up in the reservoir later. Although a seemingly excessive period of time is necessary for the increased levels to show up at station FW-2, retention of water for flood control slows movement of material through the pool.

The high ammonia nitrogen levels at station FW-2 in August are probably the result of nitrate and nitrite oxidizing during period of low flow. Although the lake did not stratify it is possible for this reaction to proceed under less than optimum conditions.

The various forms of nitrogen are not elevated in the reservoir and feeder streams and present no water quality problem.

b. Phosphates

The phosphate curve follows the rainfall curve closely. The high phosphate levels in the fall are probably due to material leaching out of septic systems and run off from small farms where it builds up during the dry summer. The data indicates that the amount of phosphate entering the reservoir has not changed significantly since CY 1978, even though the number of second homes in the drainage area continue to increase. The increasing use of low phosphate detergents and the continued decline in farming probably offsets any increase in phosphate entering the water via the on lot sewage systems. The levels entering the reservoir are generally low and do not create a water quality problem.

1/ Stratification water samples - (Appendix B) Philadelphia District.

c. Dissolved Oxygen

Dissolved Oxygen concentrations remained within the range normally found in surface waters the entire year. The pool did not stratify, probably due to the hypolimnion drain in the reservoir, and dissolved oxygen levels remained adequate for fish life. The possibility of the lake stratifying during the winter has not been investigated. During the summer a hypolimnion drain its used to provide a cooler water for trout fishing in the Lehigh River below the dam. In the winter an epilimnion drain is used creating a pool of relatively stagnant water below the drain. Although the pool level fluctuates considerably following rain and snow storms the fluctuation may not be adequate to break the stratification.

d. pH

pH continues to be a minor problem in the F. E. Walter Reservoir. The desired range is 6.0 to 8.5; the range in the reservoir was from 4.93 to 7.41. This is below standards established by the various regulatory agencies. The source of the low pH is not known but it is felt that drainage from numerous swamps and small lakes is the primary source.

There are no coal mines in the drainage area that would contribute to the acid problem. Samples collected from the Lehigh River and Tobyhanna Creek have the same acid condition but not as severe as in the reservoir; a range of 5.7 to 7.4 with an average of 6.13 for the Lehigh River and a range of 5.9 to 7.1 with an average of 6.71 for Bear Creek.

The pH variation follows rainfall very closely. This would be expected if the sources were swamps and shallow lakes rather than a point source such as a mine drainage. Discussions with personnel from the Pennsylvania Fish Commission indicate that the Tunkhannock Creek is a major source of low pH water. This stream feeds the Tobyhanna Creek and depresses the pH following a rain storm. If the source of the acid water is shallow lakes and swamps, lignin and tannin concentrations would be high due to the decaying vegetation.

e. Total Dissolved Solids (TDS) and Specific Conductance

TDS and Specific Conductance levels tend to follow rainfall: as rainfall increases TDS and specific conductance increase. During periods of little rainfall the dissolved material will settle to the lower portions of the reservoir and enter the bottom muds. This is reflected in the stratification data for the reservoir. The normal relationship between TDS and specific conductance was not found at any of the sampling stations in the drainage, normally specific conductance exceeds TDS by about half. It is possible that high levels of organic material are non-conductive but contribute to the solids measured by the TDS test. Rather than attempting to isolate the source of the non-conductive material, the development of a nonstandard graph of the TDS-specific conductance relationship will be drawn for the conversion of values. The TDS and specific conductance readings are both low indicating an oligotrophic lake.

f. Coliform Sampling

The coliform counts at the Francis E. Walter Reservoir remained within the limits established by the Pennsylvania Department of Enviromental Resources of no more than a geometric mean of 200 colonies per 100 milliliters of sample for fecal coliform on five different days and no more than 5,000 per 100 milliliters of sample for total coliform .

The highest counts follow a period of rain, particularly after a prolonged dry spell. This indicates the most of the coliform load is the result of material being washed into the water rather than a point source. Fecal Streptococcus testing began in October of 1979 and the test results [1/] documented to date are within the criteria established by Pennsylvania Department of Environmental Resources.

CONCLUSIONS

1. The water is high quality and meets the standards established by the Federal Water Pollution Control Administration.

2. The low pH following a rainfall is a naturally occuring condition that is uncontrollable with existing technology. The effect of low pH conditions on the aquatic life has not been determined.

3. The low total and fecal coliform counts indicate minimum sewage pollution in the drainage area.

4. The chemical testing for Francis Walter Dam indicates that the Bear Creek arm of the Reservoir is extremely soft water with a marginal pH and acidity regarding aquatic life.

5-03. Fishery. The quality of the waters in the present 90 acres pool generally meet State Department of Health standards for body-contact water sports, although none are permitted at this lake. Periodic water samplings taken from various locations in the tributaries show a summertime average MPN/100 ml for fecal coliform organisms of less than 10, and an average MPN/100 ml for total coliform of 20. The pool waters have maintained an average pH of 6.17. This combination of factors combined with good water release management has resulted in the maintenance of good cold-water fisheries both downstream of the dam and in the upstream major tributaries. A popular warm-water fishery is also maintained in

1/ (Appendix A) Contract, BCM, Coliform Data

the impoundment as a result of water quality and management practices. Both of these fisheries are supplemented by periodic stocking by the Pennsylvania Fish Commission. There have been no occurrences of algal blooms or other warnings of eutrophication recorded at the project. Access to the lake for most fishermen is from the boat launching area on the right bank of the dam, or by hiking along the shoreline. Most fishing at Francis E. Walter lake is done from boats. Downstream fishing sites in the reservoir tail waters and the Lehigh River are accessible by hiking in from the parking lot by the spillway, the gaging station road, or from the Fawn Run parking lot.

The U.S. Fish and Wildlife Service has stocked Francis E. Walter Reservoir and the downstream areas with species of warm water gamefish and trout on an annual basis. Trout stocking is done in recognition of the potential of the reservoir to support a cold water fishery and to augment the put-and-take stocking practice which is a part of the Commonwealth of Pennsylvania's trout management program. The Pennsylvania Fish Commission has determined that the lake is most suitable for walleye and possibly smallmouth bass. The steep slope of the shoreline will limit spawning success of many other species.

1980 Pennsylvania Fish Stocking at Walter Lake.

March 28	4,750 Brook Trout, all in the reservoir
May 26	4,750 Brook Trout, all in the reservoir

SECTION VI - RECOMMENDATIONS AND PROPOSED STUDIES

6-01. General. The following recommendations are made relative to the water quality management and control at Francis E. Walter Dam and Reservoir.

a. Continue the present sampling frequency to help maintain surveillance over the water quality in the lake.

b. Correlate data collected from other agencies and establish their sampling locations, procedures, and equipment used for testing.

c. Support state efforts in collection and analysis of algae and coliform data for the lake.

d. An expanded program of sampling chemical profiles in the lake, especially while the lake is thermally stratified to establish the relationship of thermal stratification to chemical stratification.

e. Enlist the services of the Pennsylvania DERS Water Quality Section and laboratory facilities to expand our present sampling points and test for additional physio -chemical, bacteriological and biological parameters.

f. Investigate the source of low pH levels in the Reservoir.

6-02. Findings and Conclusions. The water sampling program will continue essentially unchanged for F.Y. 1981 at Francis E. Walter Lake and its tributaries.

The water sampling data collected during calendar year 1980 indicates that the water quality in Francis E. Walter Lake remains within the standards established by Pennsylvania (DER) and the U. S. Environmental Protection Agency. In general, following periods of heavy precipitation, there is a slight increase in ammonia nitrogen and phosphorous levels with a decrease in the pH levels. This is associated more with runoff from surrounding areas and is not a direct function of the reservoir. During periods of extreme rainfall, Bear Creek tends to exhibit the lowest pH readings which range from 4.9 to 6.2 levels. It appears that the low pH readings are a result of the flushing action of waters from upstream swamps and marshes.

Bacteriological data [1/] recorded at stream inflows are within the criteria established by Pennsylvania (DER).

Results for the parameters; such as dissolved oxygen, phosphorous, total dissolved solids, conductance, ammonia, nitrate and nitrite have remained fairly uniform; and are within allowable limits for the water samples collected and analyzed during the testing period.

1/ Appendix A

APPENDIX A

WATER QUALITY/BACTERIOLOGICAL DATA

APPENDIX 2

F.E. WALTER LAKE

WATER QUALITY DATA

WATER QUALITY DATA — F.E.WALTER LAKE — 1980

Sample Date	Site #	BOD	TP-P	NH4-N	NO3-N	NO2-N	Dissolved Solids	DO	pH	Temp	Cond	Fecal Coli	Total Coli	Fecal Strep
3/20	1	2	0.01	0.28	0.19	<0.01	52	11.8	6.6	5	50			
3/20	2	2	<0.01	0.27	0.19	<0.01	33	14.0	6.7	3	35			
3/20	3	2	0.02	0.28	0.27	<0.01	47	14.5	7.4	6	40			
3/20	4	2	0.03	0.28	0.16	<0.01	43	11.5	6.9	7	40			
3/20	5	2	0.02	0.22	0.11	0.01	43	13.0	6.3	4	60			
4/3	1	<3	0.03	0.22	0.16	<0.01	19	15.0	6.8	4	31			
4/3	2	<3	0.02	0.24	0.21	<0.01	27	13.4	7.1	7	20			
4/3	3	<3	0.04	0.23	0.21	<0.01	29	14.5	6.8	6	49			
4/3	4	<3	<0.01	0.21	0.16	0.03	16	12.5	6.8	6	57			
4/3	5	<3	<0.01	0.19	0.08	<0.01	34	15.0	6.3	5	42			
4/17	1	<3	0.02	0.16	0.12	0.01	24	12.5	6.3	5	55			
4/17	2	<3	0.05	0.12	0.12	0.01	37	12.2	6.5	7	40			
4/17	3	<3	0.07	<0.10	0.15	0.02	51	12.8	6.0	7	45			
4/17	4	<3	0.02	<0.10	0.17	<0.01	47	13.6	6.7	6	75			
4/17	5	<3	<0.01	0.11	0.05	<0.01	30	13.0	6.2	5	60			
5/8	1	3	0.01	<0.10	0.04	<0.01	50	6.2	6.8	9	22			
5/8	2	<2	<0.01	<0.10	0.03	<0.01	44	7.4	7.1	15	29			
5/8	3	2	<0.01	<0.10	0.04	<0.01	34	6.8	6.8	15	35			
5/8	4	2	0.01	<0.10	0.03	0.05	58	6.9	6.8	8	39			
5/8	5	2	0.01	<0.10	0.05	0.02	18	6.2	6.3	11	28			
5/29	1	<2	0.03	0.13	0.04	<0.01	28	9.0	6.5	17	40			
5/29	2	<2	0.03	0.10	0.04	<0.01	24	7.4	7.5	21	40	0	290	7
5/29	3	<2	<0.01	<0.10	0.07	<0.01	22	9.5	7.3	16	32	10	200	3
5/29	4	<2	<0.01	0.18	0.07	<0.01	38	10.4	7.2	15	42	22	260	3
5/29	5	<2	<0.01	<0.10	0.04	<0.01	24	9.2	6.7	11	28	13	140	1
6/19	1	<2	0.06	0.10	0.04	<0.01	68	8.2	7.4	18	37			
6/19	2	<2	<0.01	<0.10	0.06	<0.01	15	6.2	7.4	22	39	45	126	0
6/19	3	<2	<0.01	<0.10	0.08	<0.01	22	9.0	7.2	17	33	13	43	0
6/19	4	<2	<0.01	<0.10	0.07	<0.01	30	8.8	6.9	18	48	18	21	0
6/19	5	<2	<0.01	<0.10	0.04	<0.01	27	11.4	6.6	14	38	12	300	0
7/3	1	2	0.01	<0.10	0.19	<0.01	18	8.7	6.0	21	38			
7/3	2	<2	0.02	<0.10	<0.01	<0.01	36	8.2	6.5	23	40			
7/3	3	<2	0.01	<0.10	0.19	<0.01	19	8.6	6.0	19	35			
7/3	4	<2	0.03	<0.10	0.19	<0.01	30	8.8	6.5	19	40			
7/3	5	<2	0.02	<0.10	0.18	<0.01	134	9.0	6.0	18	38			
7/17	1	2	0.01	<0.10	<0.01	<0.01	33	8.3	6.6	24	40			
7/17	2	<2	0.09	<0.10	<0.01	<0.01	31	8.0	6.5	26	42	1	240	4
7/17	3	<2	<0.01	<0.10	<0.01	<0.01	31	8.4	6.4	20	35	65	160	11
7/17	4	<2	<0.01	<0.10	<0.01	<0.01	41	9.0	6.8	20	40	20	60	6
7/17	5	<2	<0.01	<0.10	<0.01	<0.01	35	9.0	6.7	19	38	37	78	6
7/30	1	<2	<0.01	0.25	0.09	0.02	34	8.1	7.2	24	50			
7/30	2	<2	<0.01	0.12	0.09	0.02	35	5.8	7.0	26	49			
7/30	3	<2	<0.01	0.10	0.11	0.02	34	8.2	6.9	19	42			
7/30	4	<2	<0.01	<0.10	0.14	0.01	47	10.0	6.9	19	48			
7/30	5	<2	<0.01	<0.10	0.11	0.01	42	9.8	7.3	18	57			

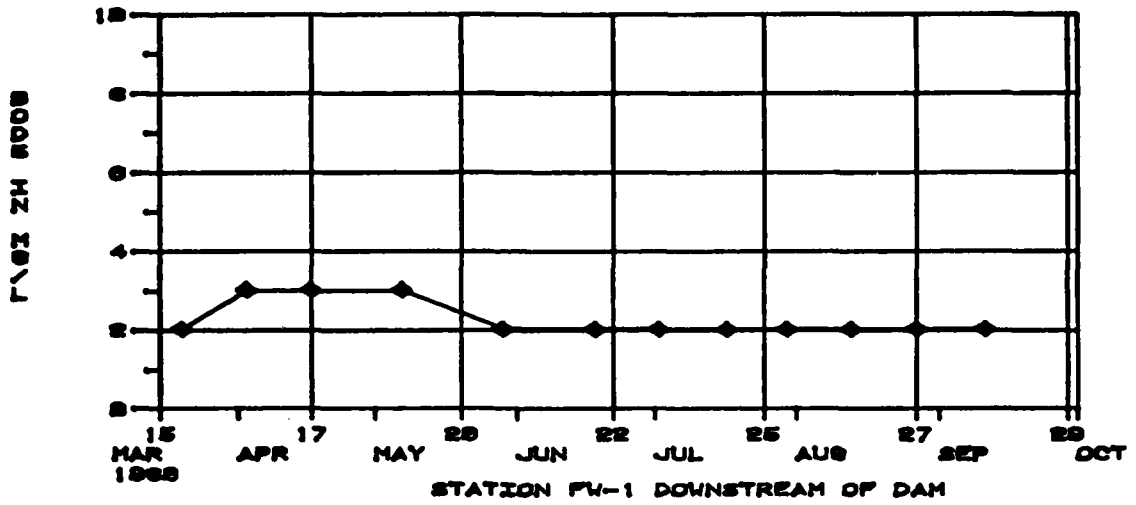
All units are mg/l except: pH in pH units, Temperature in degrees centigrade, Conductivity in umhos/cm and the bacteriological results in #/100 ml.

WATER QUALITY DATA F.E.WALTER LAKE 1980

Sample Date	Site #	BOD	TP-P	NH4-N	NO3-N	NO2-N	Dissolved Solids	DO	pH	Temp	Cond	Fecal Coli	Total Coli	Fecal Strep
8/13	1	<2	<0.01	0.10	0.13	0.04	50	6.6	6.9	24	42			
8/13	2	<2	<0.01	<0.10	0.13	0.04	50	6.6	6.9	25	42	80	200	100
8/13	3	<2	0.02	<0.10	0.11	0.12	41	7.6	6.6	20	36	20	70	20
8/13	4	<2	0.02	<0.10	0.11	<0.01	46	9.2	6.6	20	43	150	30	100
8/13	5	<2	0.02	<0.10	0.14	<0.01	37	8.8	7.2	18	40	10	120	180
8/27	1	<2	0.03	<0.10	0.11	<0.01	45	8.0	6.1	22				
8/27	2	<2	0.02	<0.10	0.05	<0.01	62	9.2	6.1	23				
8/27	3	<2	0.04	<0.10	0.12	<0.01	28	10.6	6.2	18				
8/27	4	<2	0.03	<0.10	0.07	<0.01	37	10.6	6.0	20				
8/27	5	<2	0.03	<0.10	0.07	0.01	40	11.6	6.0	18				
9/15	1	<2	0.02	<0.10	0.14	<0.10	48	8.3	7.3	22	45			
9/15	2	<2	0.04	<0.10	0.07	<0.10	58	6.4	7.8	23	50			
9/15	3	<2	<0.01	<0.10	0.11	<0.10	43	6.5	7.8	20	48			
9/15	4	<2	0.02	<0.10	0.10	<0.10	55	10.2	6.6	20	53			
9/15	5	<2	0.04	<0.10	0.10	<0.10	56	7.4	7.0	19	52			

All units are mg/l except: pH in pH units, Temperature in degrees centigrade, Conductivity in umhos/cm and the bacteriological results in #/100 ml.

F.E.WALTER WATER QUALITY DATA FOR 1988



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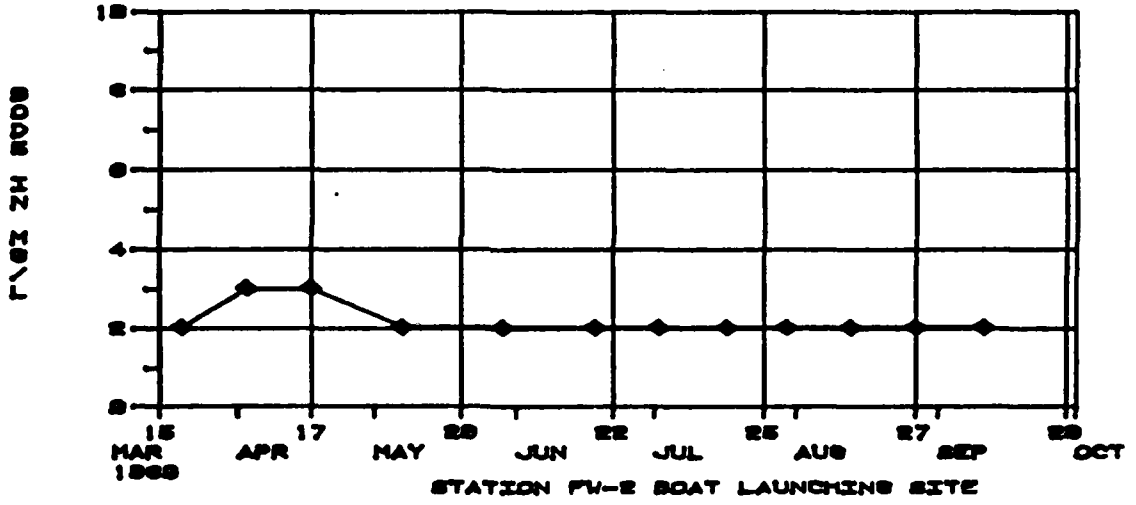

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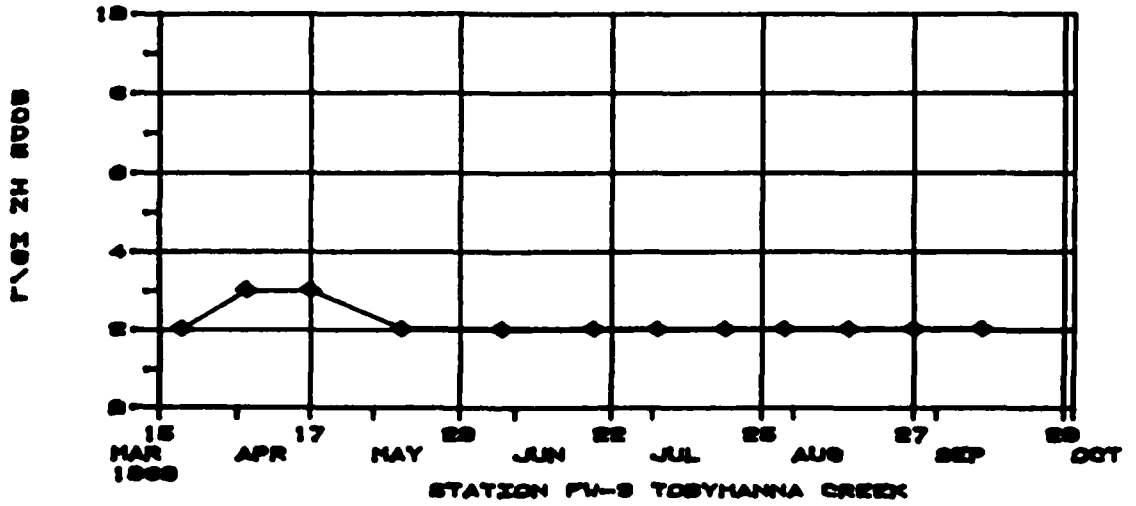

STATION FW-3 TOBYHANNA CREEK

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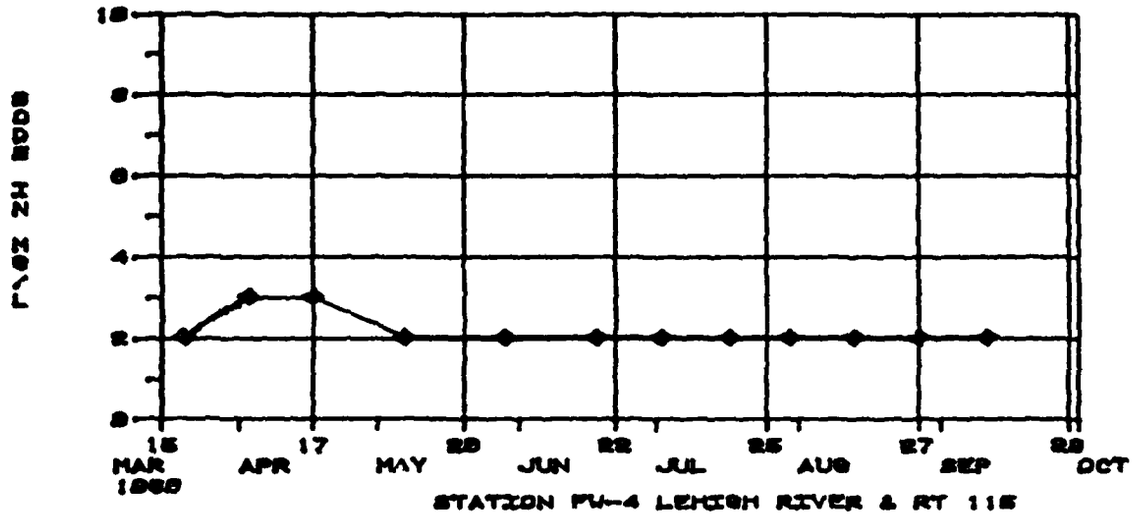

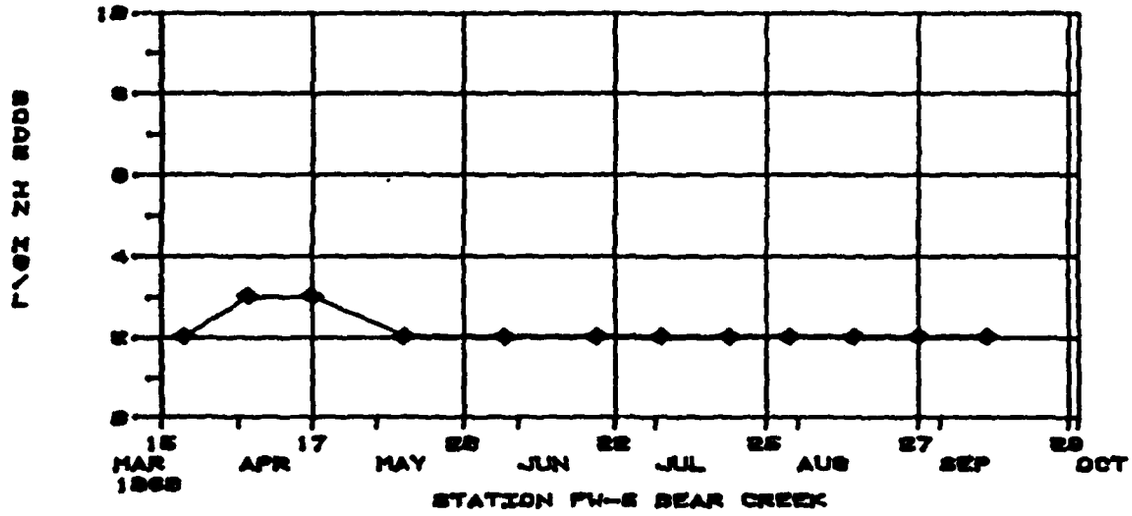

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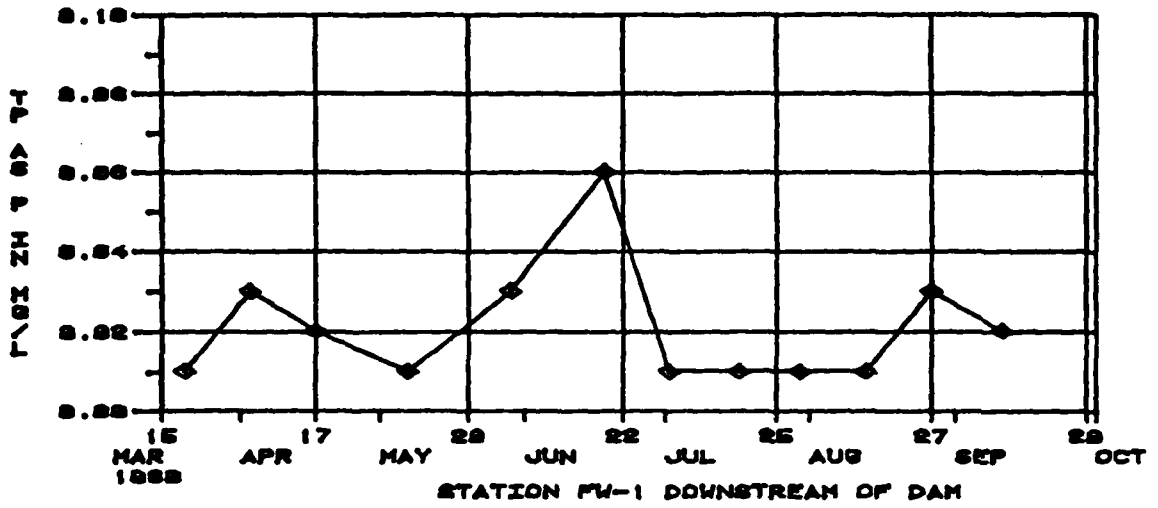

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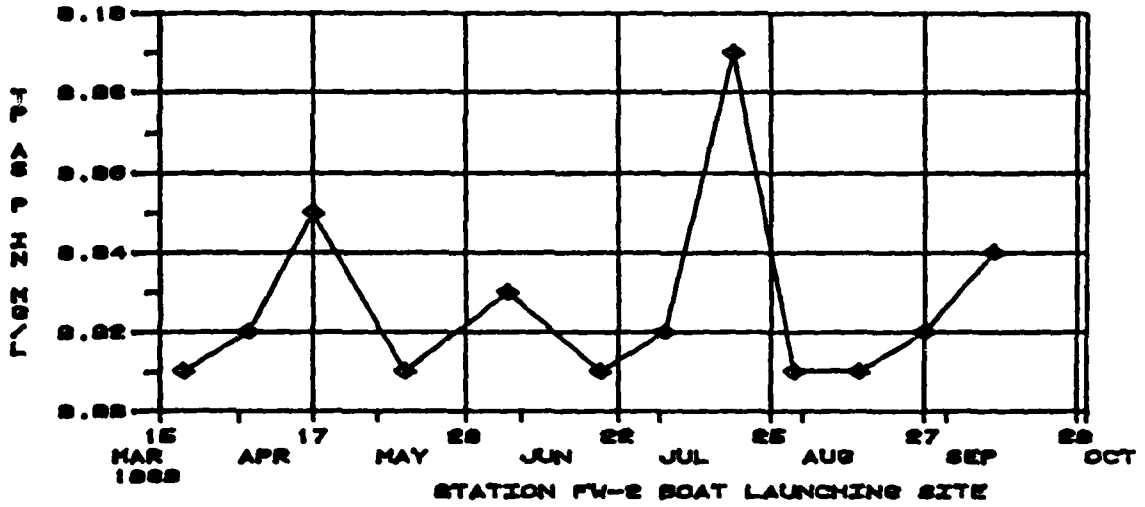

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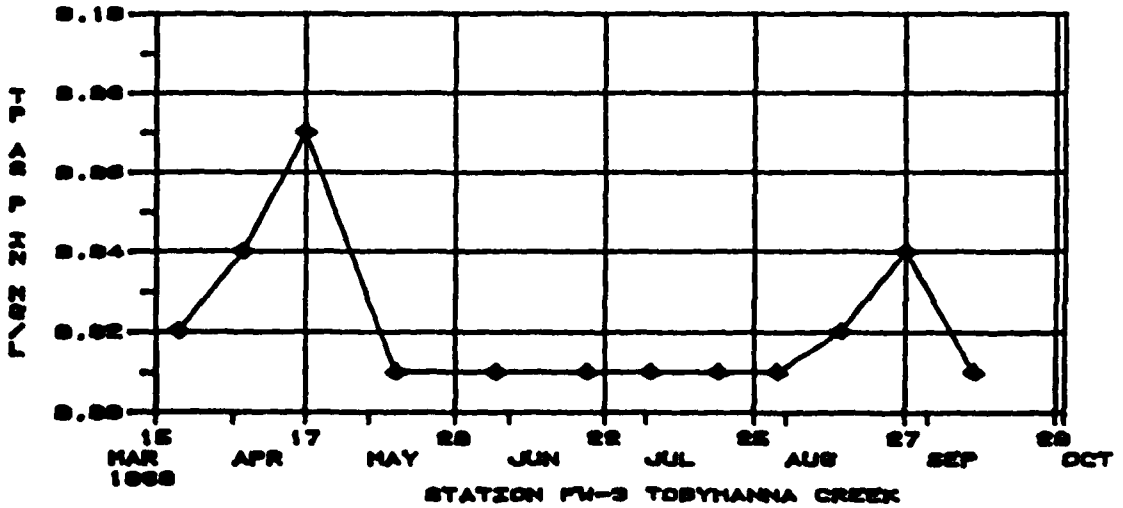

STATION FW-3 TOBYHANNA CREEK

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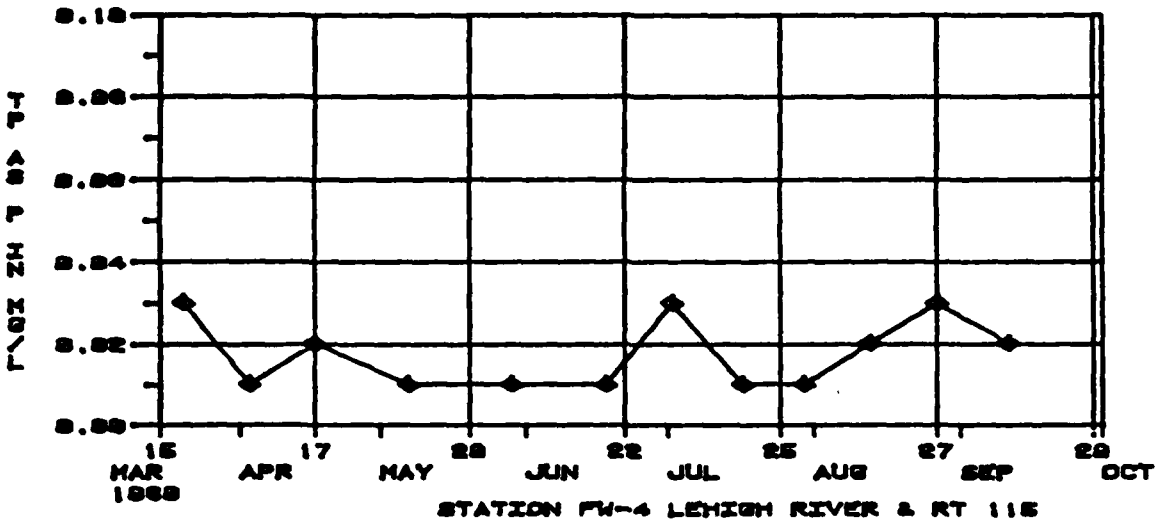

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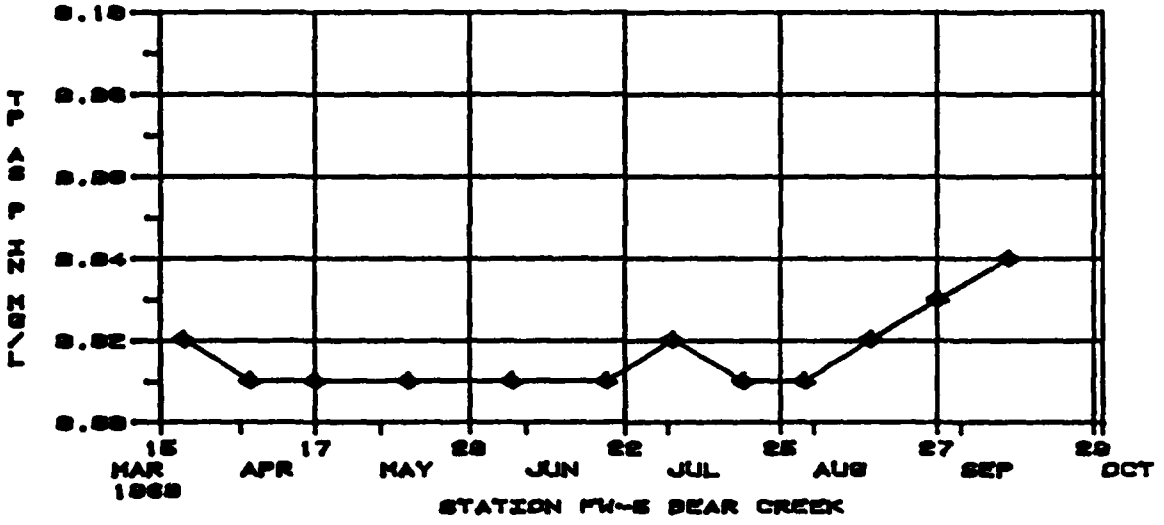

STATION FW-5 BEAR CREEK

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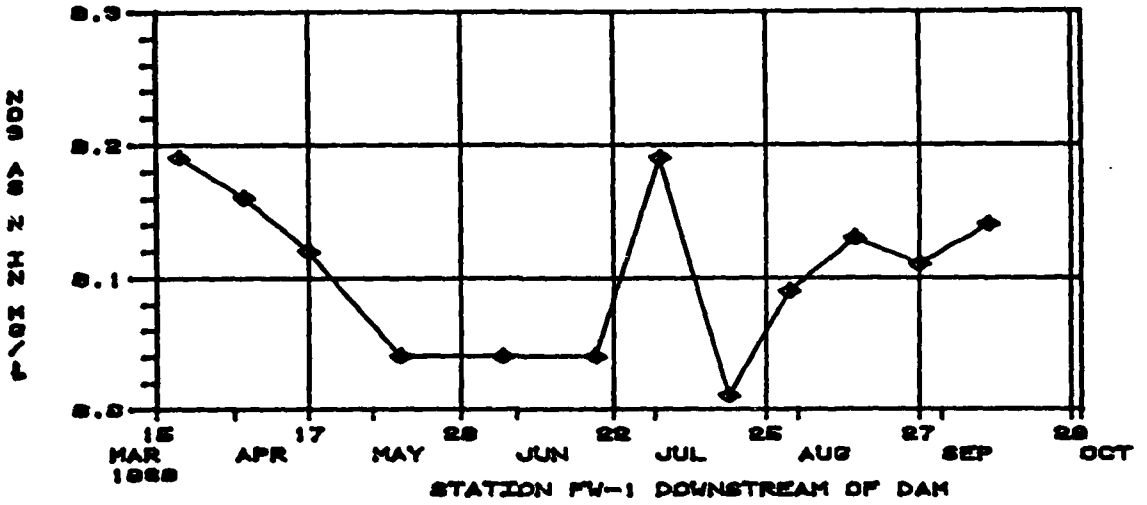

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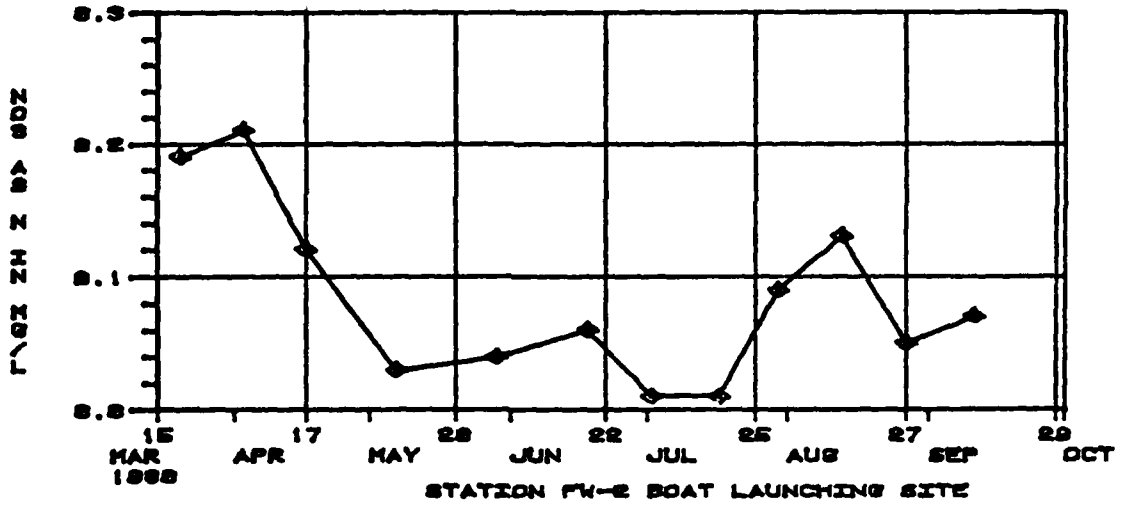

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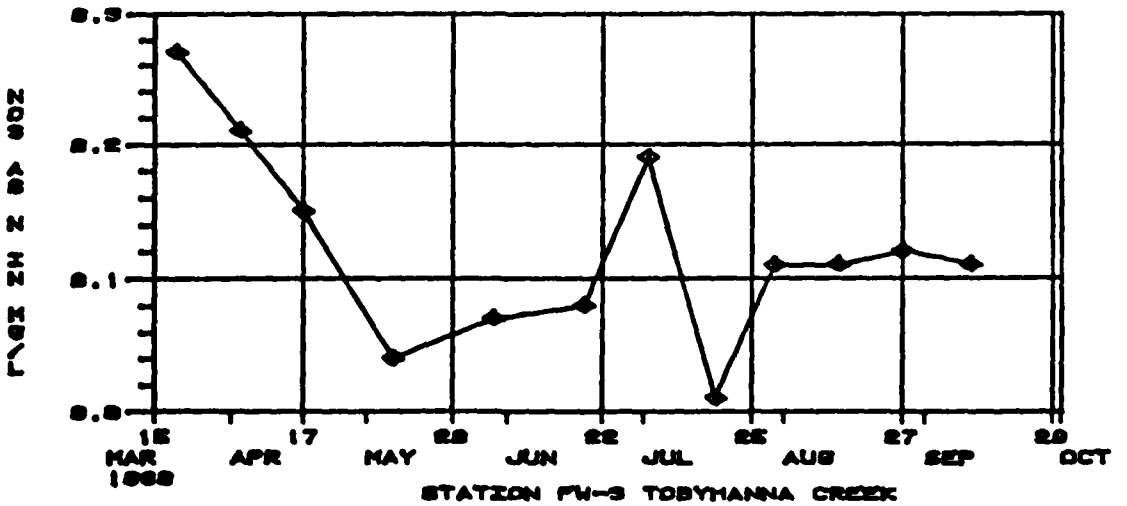

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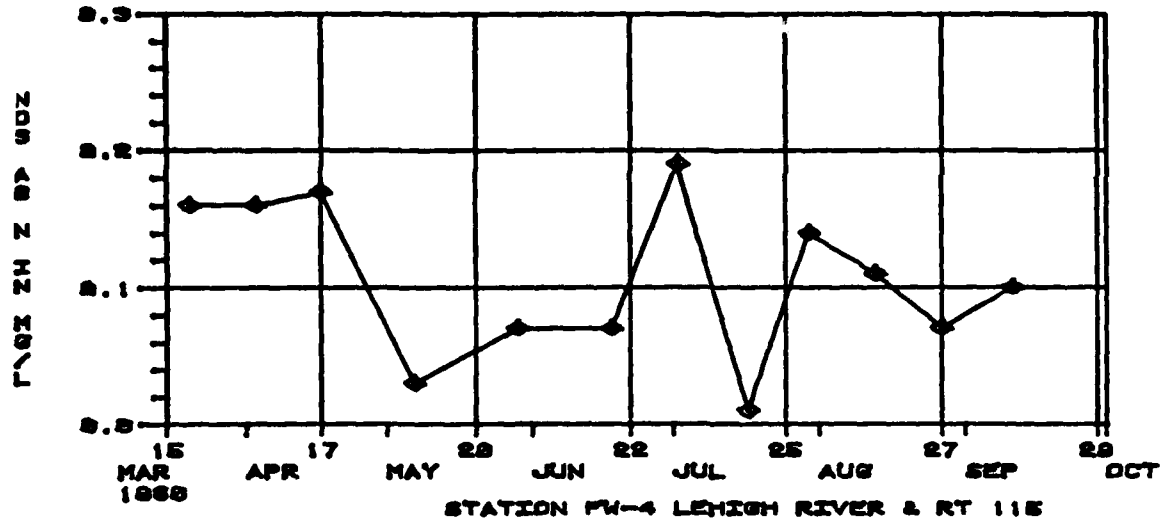
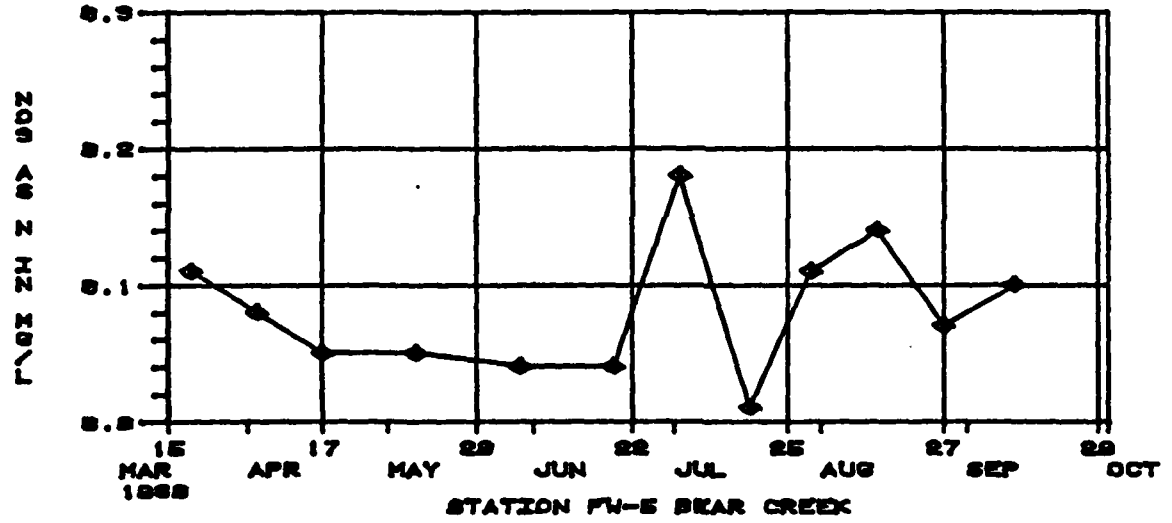
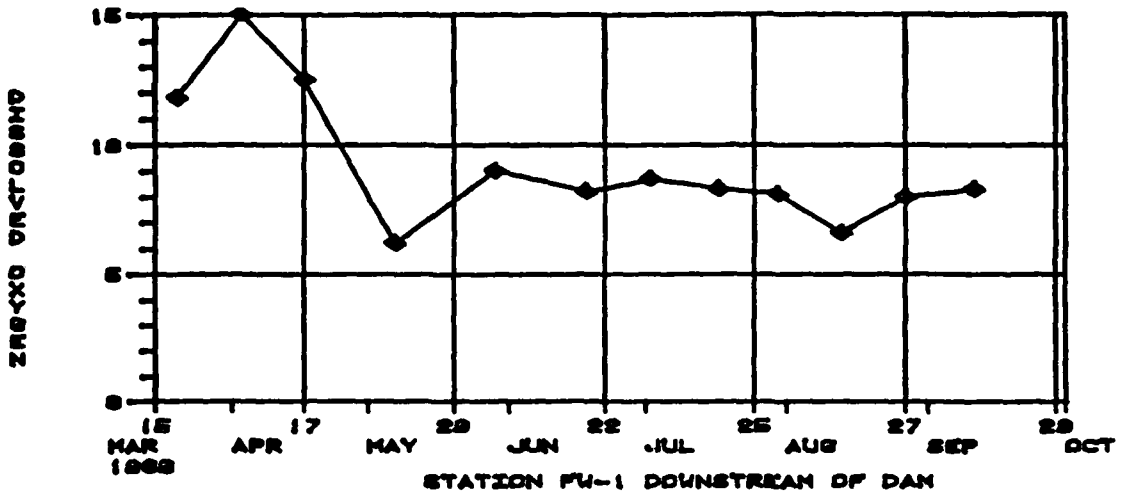
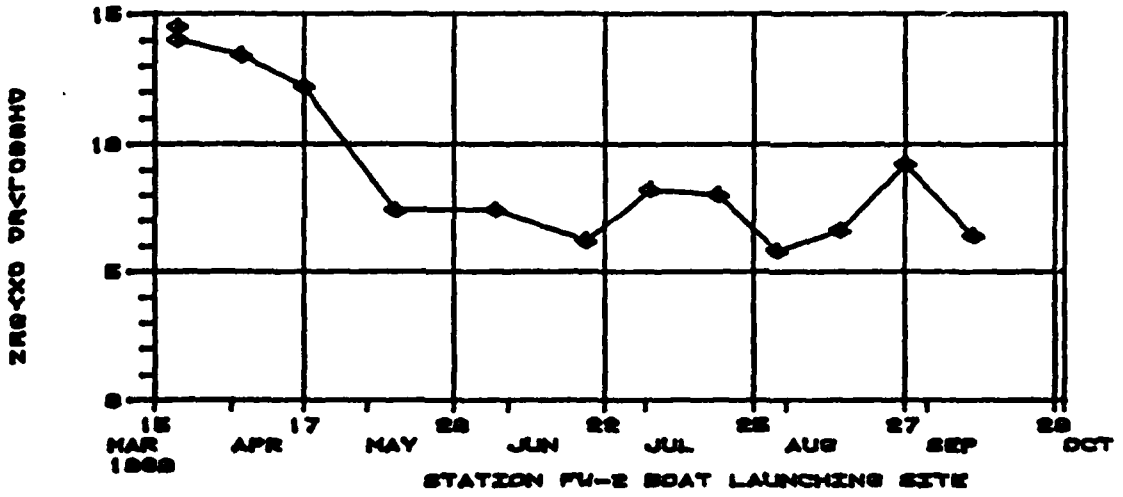
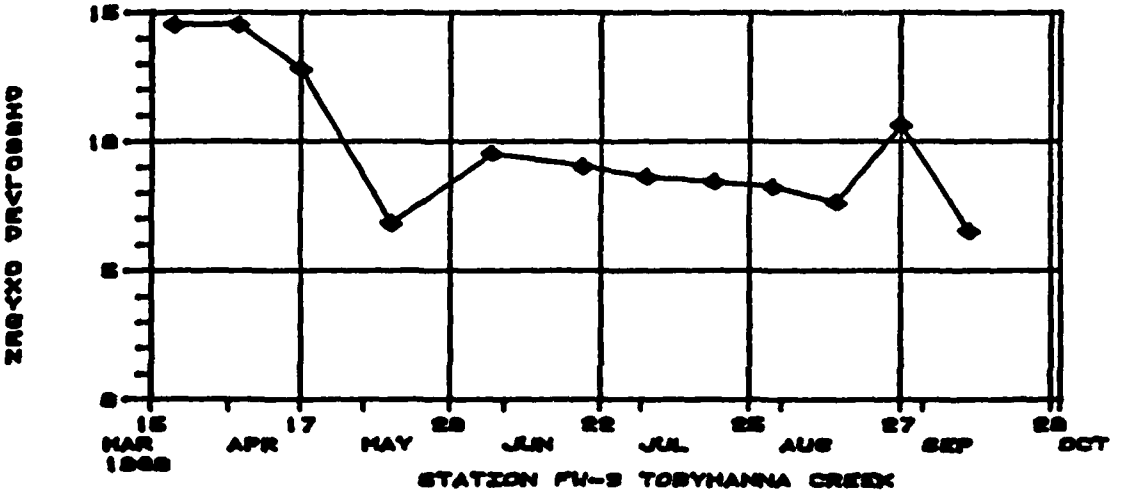




F.E.WALTER WATER QUALITY DATA FOR 1988







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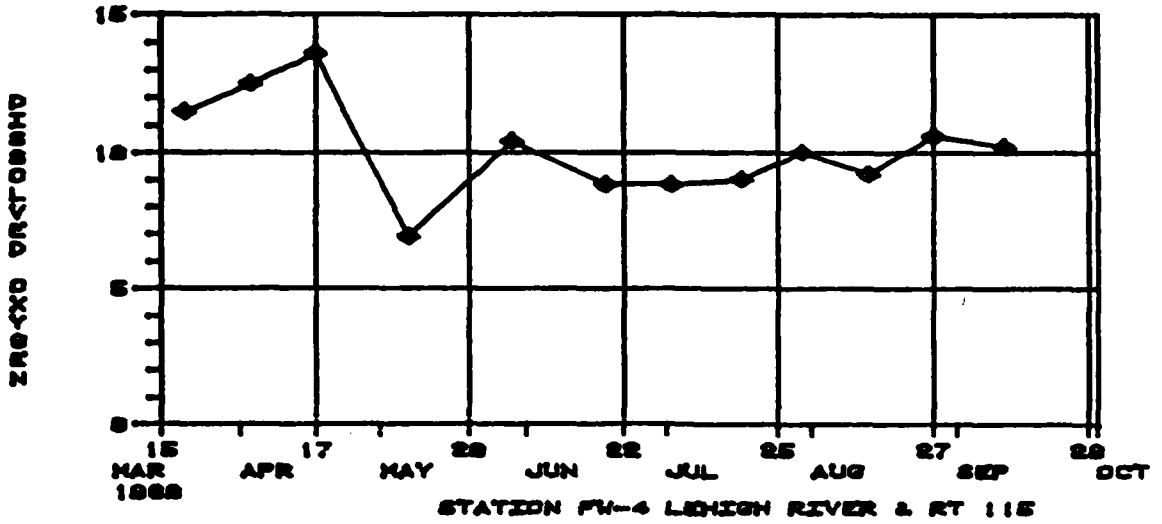
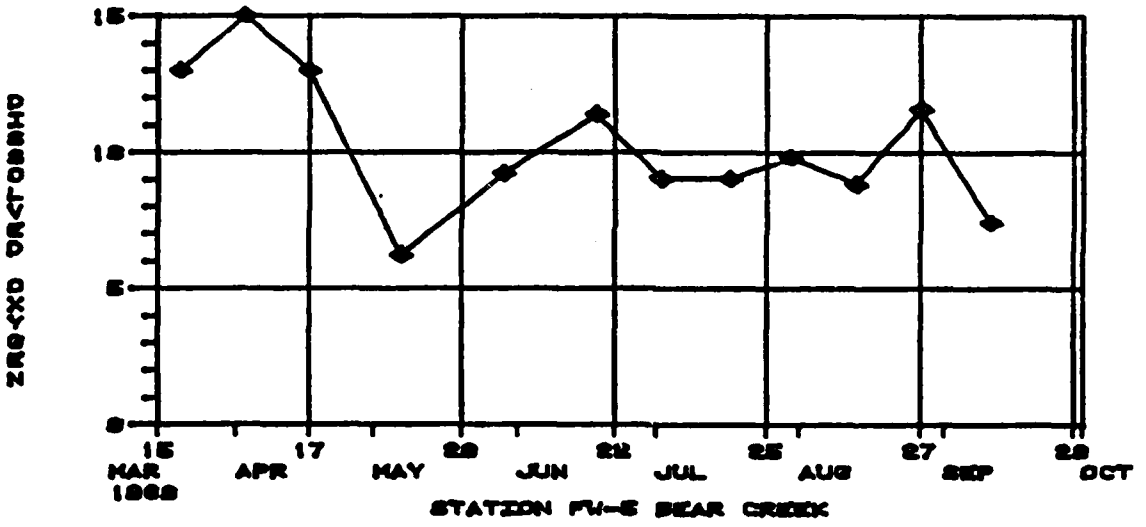




TABLES

TABLE 1

FRANCIS E. WALTER DAM
CLIMATOLOGICAL DATA - 1980
(January thru June)

	Precip. (inches)	Total Snow on Ground (inches)	Avg. Temp. (°F)	High Temp. (°F)	Low Temp. (°F)	Days With Precipitation
Jan	.73	2.0	24.0	52	3	2
Feb	1.00	13.5	19.6	49	-8	4
Mar	4.72	9.0	30.8	57	-4	13
Apr	3.98	3.0	45.3	70	21	13
May	1.76	0	56.7	87	27	7
June	3.17	0	60.1	86	29	11

TABLE 2

STREAM FLOW CHARACTERISTICS: LEHIGH RIVER

Gaging Station	Years Of Available Record	Average Flow (cfs)		Maximum Flow (cfs)		Minimum Flow (cfs)	
		in 1971	Over Total Gaging Period	in 1971	Over Total Gaging Period	in 1971	Over Total Gaging Period
Francis E. Walter Dam	10	655	555	3,120	13,800	66	22
Bear Creek	3.5	108	89.2	326	> 326	7.4	4.8

CORPS OF ENGINEERS

U.S ARMY

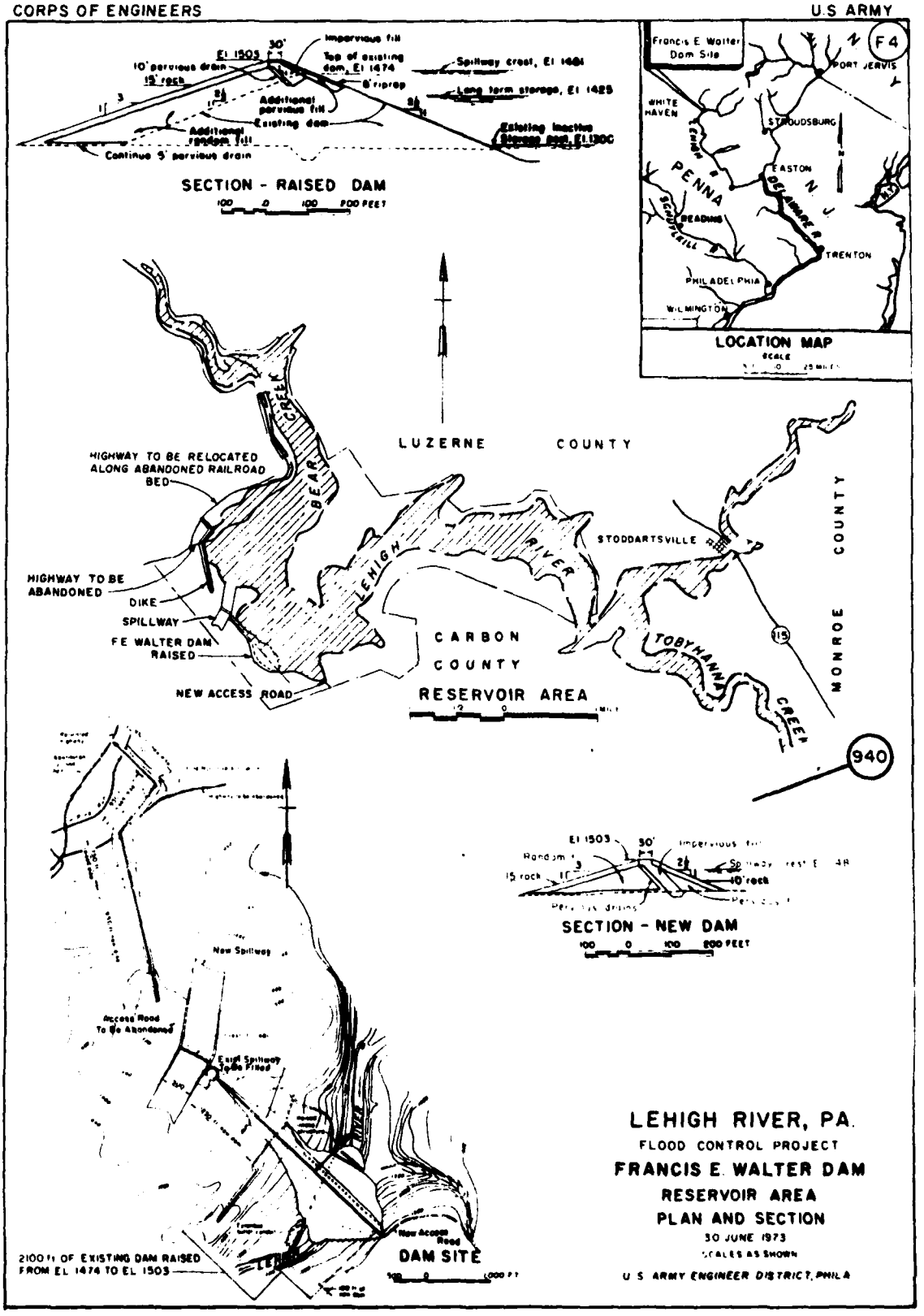
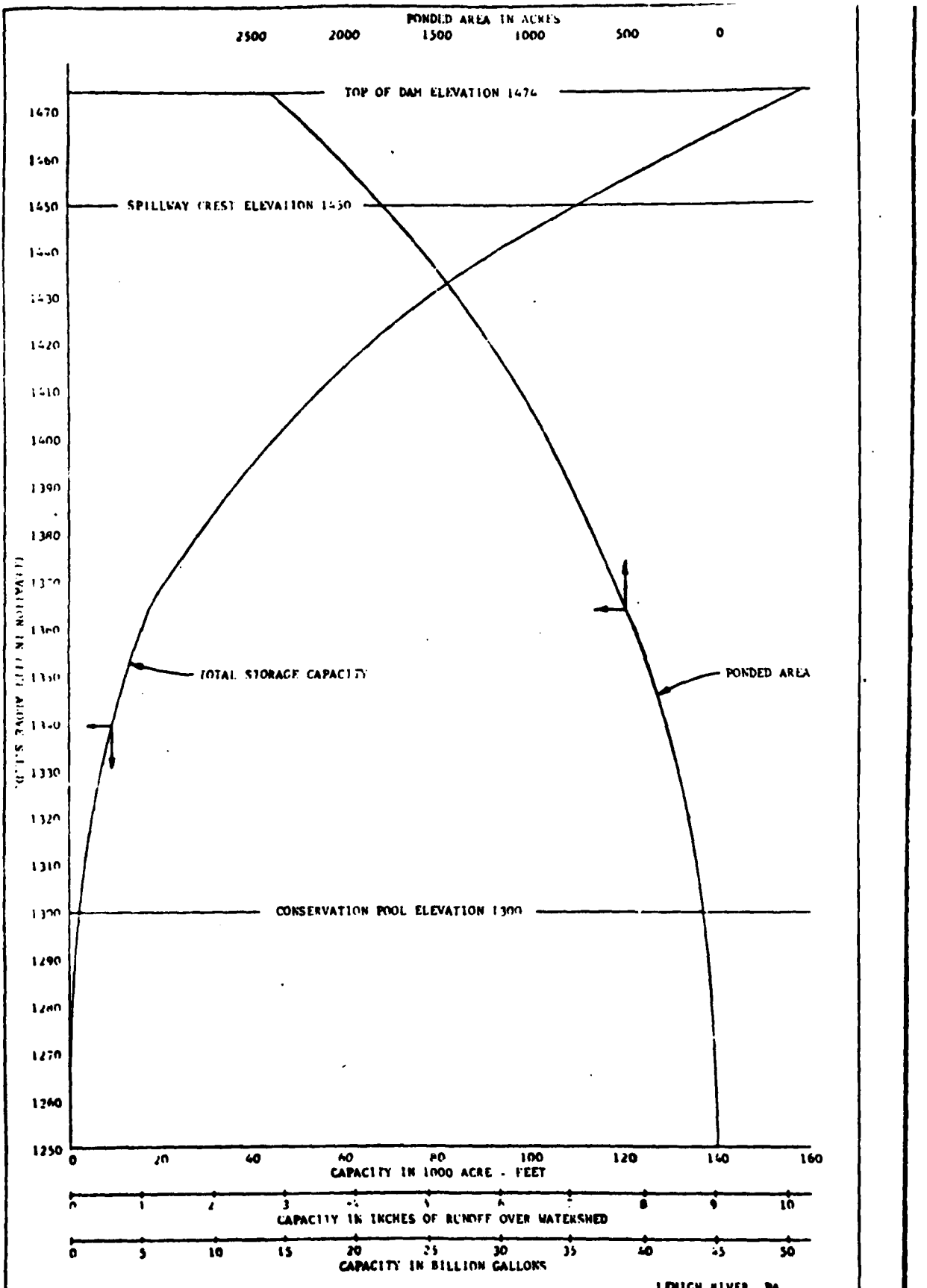


PLATE 1



LEHIGH RIVER, PA.
FRANCIS E. WALTER RESERVOIR
ELEVATION VS. TOTAL CAPACITY
AREA & CAPACITY

PLATE 2

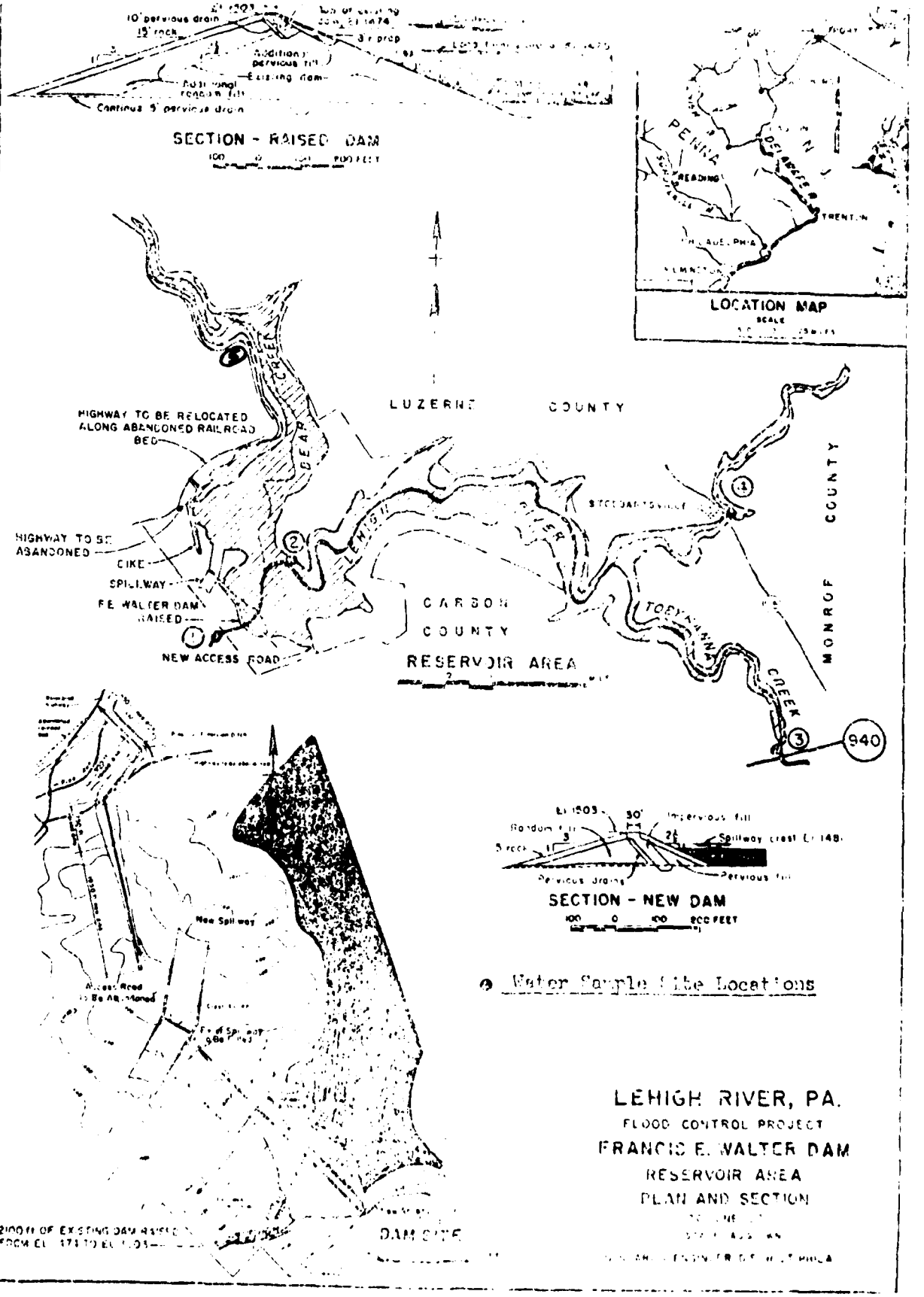

SECTION - RAISED DAM
LOCATION MAP
LUZERNE COUNTY
MONROE COUNTY
CARBON COUNTY
HIGHWAY TO BE RELOCATED ALONG ABANDONED RAILROAD BED
HIGHWAY TO BE ABANDONED
DIKE
SPILLWAY
FE WALTER DAM RAISED
NEW ACCESS ROAD
RESERVOIR AREA
BEAR CREEK
LEHIGH
TOBYHANNA CREEK
SECTION - NEW DAM
Water Sample Site Locations
LEHIGH RIVER, PA.
FLOOD CONTROL PROJECT
FRANCIS E. WALTER DAM
RESERVOIR AREA
PLAN AND SECTION

PLATE 3


DATE
ILME